REMARKS

Reconsideration and allowance of the above-amended application are respectfully requested.

The drawings and specification have been amended to correct various informalities pointed out by the examiner. No new matter is added. FIGS. 1, 2, and 12 have been amended as indicated in the attached sheets with amendments marked in red ink. FIGS. 3A and 3B have been amended per examiner's suggestion because FIGS. 3A and 3B show implementations of the present invention as described on page 21 of the specification. A set of new formal drawings will be filed shortly. The undersigned asks the examiner to allow for correction of the informalities on pages 7 and 9 (as pointed by the examiner) to be made at a later time.

With respect to the claims, Claim 1 has been amended based on the description on pages 31, 42, and 48 of the specification. In addition, Claims 40 and 41 have been newly added to specifically recite the thick barriers described on pages 31, 42, and 48. No new matter is added.

Claims 1, 3, 4, 11-16, 36, 38, and 39 stand finally rejected under 35 USC 112, second paragraph, as being indefinite for using the terms of "sufficiently thick" and "substantially eliminate." Claim 1 has amended to specifically recite that the

thickness is at least 500 angstroms. This amendment clarifies the terms of "sufficiently thick" and "substantially eliminate." Therefore, the claims are now definite and are patentable under 35 USC 112, second paragraph.

Claims 1, 3, 4, 11-16, 36, 38, and 39 also stand finally rejected under 35 USC 103(a) as being obvious over Bois in view of Steele. Bois is cited to show a design for a dual-color quantum well detector based on GaAs. Steele is cited to show a bound-to-quasi bound transition. The Office Action contends that the combination of Bois and Steele would show each feature in the pending claims.

The pending claims recite efficient dual-band QWIP sensing devices with features to enhance production of photocurrent and to suppress the dark current at the same time. The enhancement of production of photocurrent is achieved by making the excited energy state of an intersubband transition to be "substantially resonant with an energy of the well top." One aspect of the invention is the recognition that this feature alone is not sufficient because the dark current may greatly degrade the device performance even when the photocurrent is large. See the original specification, e.g., page 7, line 19 to page 8, line 16; page 10, lines 15-22; page 27, lines 1-8; and page 30, line 16 to page 31, line 5. In particular, the equation on page 8 shows that the detection efficiency is inversely proportional to

the square root of the dark current. Hence, reduction of the dark current caused by the tunneling effect is an important feature.

Based on the above recognition, the inventors discovered that the thick barriers can effectively reduce the dark current without compromising the efficiency in producing the photocurrent. This is because the excited energy state is resonant with the well top to allow the photo-excited carriers to contribute to the photocurrent without tunneling through the barriers. Claim 1 as amended recites such thick barriers by stating that "said barrier layers are sufficiently thick with a thickness of at least 500 angstroms to substantially eliminate carrier tunneling." This feature is fully supported by the original specification. See, e.g., the description on pages 31, 42, and 48 of the specification. A combination of a low dark current by using the thick barriers and a high photocurrent by the bond-to-quasibond intersubband transition can produce a highly efficient detector.

Steele fails to disclose the recited feature of thick barriers that are "sufficiently thick with a thickness of at least 500 angstroms to substantially eliminate carrier tunneling." Nothing in Steele describes or suggests anything on reduction of the dark current. Steele certainly does not suggest any thick barriers as recited in amended Claim 1.

Steele describes the barrier thickness to be 192 angstroms. For purposes of eliminating the tunneling contribution to the dark current, barriers with a thickness around 192 angstroms are still "leaky." For this reason, the inventors of this application used thick barriers of at least 500 angstroms to prevent tunneling of carriers that are not excited by the input radiation. In examples described on pages 31, 42, and 48 of the specification, the minimum barrier thickness is 500 angstroms. On page 32, for example, the preferred barrier thickness is from 500 to 600 angstroms, at least 5 times thicker than the barriers in conventional QWIP devices.

Similar to Steele, Bois is completely silent on this feature of thick barriers for reducing contribution to the dark current through tunneling. Therefore, the combination of Bois and Steele fails to disclose each feature of Claim 1 as amended. Under 35 USC 103(a), Claim 1 as amended is distinctly different from, and thus is patentable over, Bois and Steele. Other pending claims are patentable based on the above arguments as well as their own merits. Accordingly, Claims 40 and 41 are patentable over Bois and Steele.

In view of the above, all rejections to the claims have been overcome. Hence, each pending claim is now in condition for allowance. A notice of appeal is filed concurrently to appeal the finality of rejections.

A check for extension of time for 3 months in responding the Final Office Action is attached. Please apply any applicable charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

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